

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A REVIEW OF THE CORAL TOADFISHES OF THE
GENUS *SANOPUS* WITH DESCRIPTIONS OF TWO NEW
SPECIES FROM COZUMEL ISLAND, MEXICO

BY BRUCE B. COLLETTE

*National Marine Fisheries Service Systematics Laboratory,
National Museum of Natural History, Washington, D.C. 20560*

Two species of western Atlantic toadfishes have been known only from their original descriptions: *Opsanus barbatus* Meek and Hildebrand, 1928, based on the holotype from Colon, Panamá, and *Opsanus astrifer* Robins and Starck, 1965, based on five specimens from the Turneffe Islands, Belize (British Honduras). Smith (1952) named the genus *Sanopus* for *O. barbatus* because of its higher number of dorsal fin rays (24-27 in *Opsanus* vs. more than 30 in *Sanopus*). *O. astrifer* was transferred to *Sanopus* based on its agreement with *O. barbatus* in high number of fin rays and absence of distinct pectoral fin glands (Collette, 1966). New material of *S. barbatus* and *S. astrifer* collected by George C. Miller and David W. Greenfield, respectively, stimulated Collette to write a short paper diagnosing *Sanopus* and its two species. At about the same time, Walter A. Starck II was planning to describe two new species of toadfishes that he had collected around Cozumel Island, México. Independently, Craig Phillips obtained specimens of one of these species and planned to describe it. In the interests of having a complete review of the genus, we have combined forces with Collette writing the review and Starck and Phillips participating in the description of the two new species. A total of 26 specimens of *Sanopus* is now available: 12 *S. barbatus*, 7 *S. astrifer*, 6 *S. splendidus* n.sp. Collette, Starck, and Phillips and 1 *S. johnsoni* n.sp. Collette and Starck.



METHODS AND MATERIALS

At the subfamily level, important characters in the Batrachoididae include presence or absence of photophores and of hollow spines connected to venom glands (Smith, 1952; Collette, 1966). At the generic level, characters such as the presence or absence of scales and the nature of the glands around the pectoral fin region (Collette, 1966) are important. Other useful characters include number of vertebrae (precaudal and caudal), number of fin rays (dorsal, anal, and pectoral), number and shape of teeth, shape of anterior nostril tube (Roux, 1971), number of lateral lines, number of opercular and subopercular spines, and number and shape of barbels, flaps, and cirri on the head and body. Within *Sanopus*, the most important species characters are the relative branching of barbels on the chin and head and the color pattern. Numbers of fin rays and vertebrae are more valuable than morphometric characters.

Counts of vertebrae and dorsal and anal fin rays were made with the aid of radiographs. All dorsal and anal elements were counted. Vertebral counts include the two hypural vertebrae. Two factors cause difficulties in counting teeth. Teeth are frequently broken or missing, leading to low counts when estimating the number of empty sockets. High counts result from counting extra replacement teeth. To arrive at the best estimate for the number of teeth on the premaxillary, palatine, and dentary bones, counts for left and right sides were averaged and rounded off to the nearer higher whole number. These averaged numbers are used in the species descriptions (except for the vomer, for which total counts are given). Papillae were counted along the dorsal lateral line from above the opercular spine to the caudal base and along the ventral lateral line from between the pectoral and pelvic fin origins to the caudal base. Standard length was measured from the tip of the upper jaw to the caudal base. Head length extends

←

PLATE I. *Sanopus splendidus* Collette, Starck and Phillips, n.sp., Cozumel I., México. Photograph by Hans Flaskamp.

to the most posterior part of the opercular flap. Head width was measured at its maximum point. Orbit length is the maximum length of the clear part of the orbit. Interorbital width is the least distance between the clear parts of the two eyes. Snout to second dorsal and snout to anal are straight line distances to the origins of these fins. Pectoral fin length is measured from the upper base of the fin to the tip of the longest ray; pelvic fin length from the outer base to the tip of the longest ray.

Material examined is in the following collections: ANSP (Academy of Natural Sciences, Philadelphia); CAS (California Academy of Sciences, San Francisco); FMNH (Field Museum of Natural History, Chicago); MCZ (Museum of Comparative Zoology, Harvard University); SIO (Scripps Institution of Oceanography, La Jolla, California); UCR (University of Costa Rica, San Jose); UMML (University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami); UP (Departamento de Biología Marina, Universidad de Panamá); and USNM (U.S. National Museum of Natural History, Washington).

Sanopus Smith

Sanopus Smith, 1952:314 (type-species, by original designation, *Opsanus barbatus* Meek and Hildebrand).

Diagnosis: A genus of the subfamily Batrachoidinae (lacks hollow dorsal and opercular spines connected to venom glands and lacks photophores). Closest to *Opsanus*, which it resembles in six characters: body scaleless; three solid spines in first dorsal fin; an axillary pore (leading to a group of glands) present behind pectoral fin; anterior nostrils at the ends of narrow tubes arising from flaps projecting beyond upper jaw; two opercular and one subopercular spines; second dorsal rays 24 or more. Differs from *Opsanus* in several important characters as summarized in Table 1. No discrete glands on the posterior surface of the pectoral fin between bases of the upper fin rays. Only one fin ray supported by the last dorsal and anal pterygiophore (usually two in *Opsanus*). The species of *Sanopus* are longer-bodied than the species of *Opsanus* as reflected in the higher numbers of vertebrae; dorsal and anal fin rays; papillae along the dorsal and ventral lateral lines. Correlated with the larger size of *Sanopus*, adults develop more teeth: premaxillary 29–44 vs. 20–28; dentary 21–32 vs. 13–21; palatine 12–22 vs. 9–15; and total vomerine teeth 7–15 vs. 5–10.

TABLE 1. Diagnostic characters of *Opsanus* and *Sanopus*.

Character	<i>Opsanus</i>	<i>Sanopus</i>
Pectoral fin glands	6-16 well-developed glands between upper rays on posterior surface of fin	absent
Number of rays on last dorsal and anal pterygiophores	usually 2	always 1
Precaudal vertebrae	9 or 10	11, occasionally 12
Caudal vertebrae	23-25	26-29
Total vertebrae	31-36	37-41
Dorsal fin rays	23-27	29-34
Anal fin rays	19-23	24-28
Upper lateral line papillae	24-30	30-41
Lower lateral line papillae	21-26	27-36
Premaxillary teeth (one side)	20-28	29-44
Dentary teeth (one side)	13-21	21-32

Sanopus barbatus (Meek and Hildebrand)

Figs. 2 and 3

Opsanus barbatus Meek and Hildebrand, 1928:917-918 (original description; Colon, Panamá; USNM 81009; pl. 91).—Walters and Robins, 1961:13 (comparison with other species of *Opsanus*).—Robins and Starck, 1965:249-250 (comparison with *O. astrifer*).

Sanopus barbatus.—Smith, 1952:314 (type-species of *Sanopus* Smith). Collette, 1966:848 (genus recognized as valid).—Randall, 1968:285 (listed).

Diagnosis: *S. barbatus* is similar to *S. johnsoni* and different from *S. astrifer* and *S. splendidus* in having branched chin barbels, brown dorsum with mottled belly, and generally higher counts. It differs from *S. johnsoni* primarily in the nature of the branching of the barbels. The main barbels are shorter and thicker in *S. barbatus* and the branches are also short and thick (compare Figs. 1c and 1d). The papillae along the lateral line are much shorter and wider in *S. barbatus* than in *S. johnsoni* (compare Fig. 5c with 5d). No cirri are present on the interorbital region of *S. barbatus* as they are on *S. johnsoni*. Pectoral fin shorter than in *S. johnsoni* (157-166 vs. 175 thousandths of SL, Table 2).

Frequency distributions of counts (except teeth) presented in Table 3. Dorsal fin rays III, 31-34, usually III, 33; anal fin rays 25-28; pectoral fin rays 20-22, usually 20-21; vertebrae (11-12) + (28-29) = 39-41,

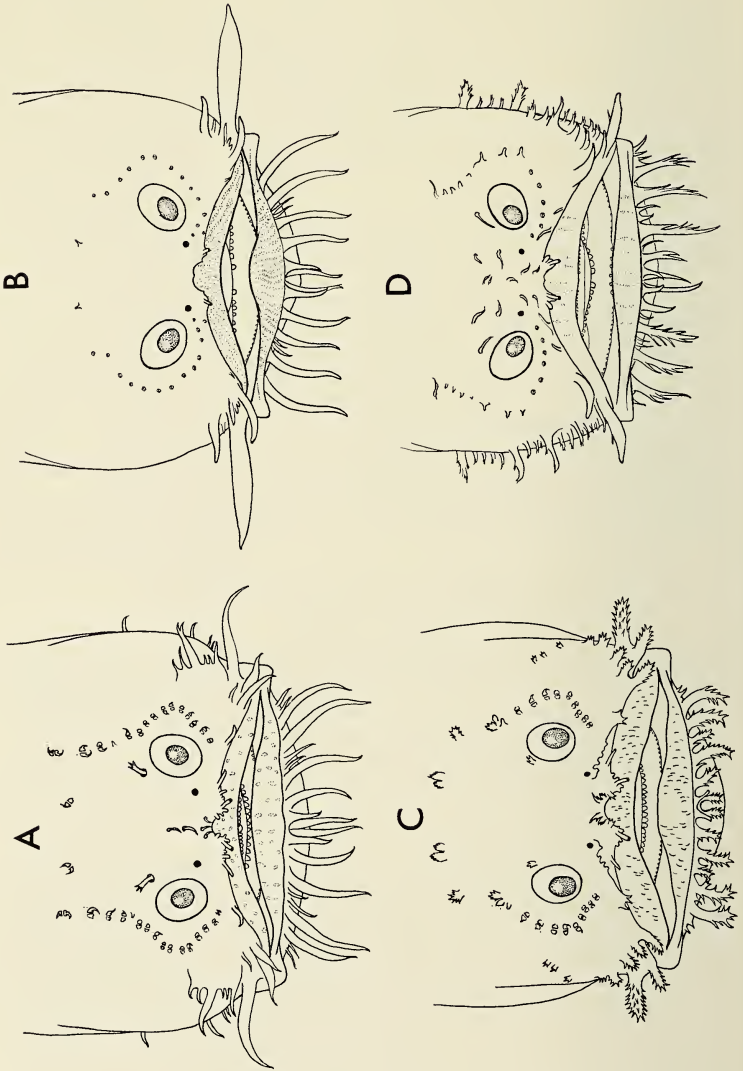




FIG. 2. Anterodorsal view of head of *Sanopus barbatus* (UCR 442-2, 370 mm SL, Uvita I., Costa Rica).

usually 40; upper lateral line papillae 32–38; lower lateral line papillae 27–34; dentary teeth 21–32 (\bar{x} 25.4); palatine teeth 12–22 (\bar{x} 16.4); premaxillary teeth 29–39 (\bar{x} 34.3); and total vomerine teeth 8–15 (\bar{x} 9.0).

Changes with growth: Comparisons can be made between seven large specimens (213–370 mm SL) and five juveniles (two, 92.1–97.4 mm, and three 28.7–36.0 mm). Juveniles have larger eyes, longer pectoral and pelvic fins, narrower heads and interorbital distances and shorter snout to second dorsal and snout to anal origin distances (Table 2). Meristically, counts of fin rays, vertebrae, and lateral line papillae do not change with size. The number of teeth on all four toothed bones

←

FIG. 1. Diagrammatic anterodorsal views of heads of four species of *Sanopus*. A. *S. astrifer* (USNM 209720, 245 mm SL, Glovers Reef, Belize). B. *S. splendidus* n.sp. (holotype, USNM 205944, 245 mm SL, Cozumel I., México). C. *S. barbatus* (USNM 211322, 250 mm SL, Bonacca, Honduras). D. *S. johnsoni* n.sp. (holotype, USNM 205945, 253 mm SL, Cozumel I., México).

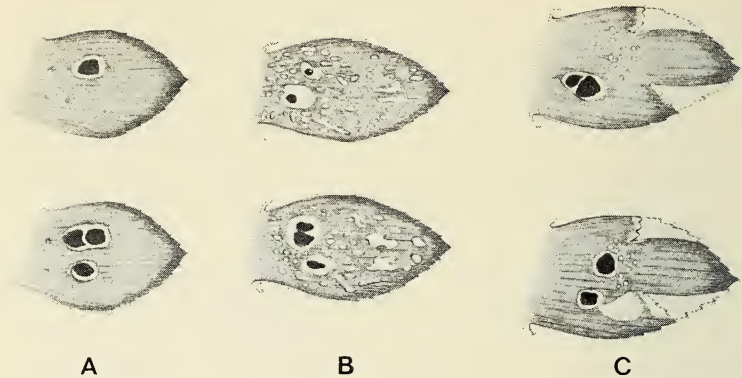


FIG. 3. Diagrammatic views of left and right sides of caudal fin of three large *Sanopus barbatus* to show caudal ocelli. A. USNM 81009, 329 mm SL, Panamá, holotype. B. UP 736, 355 mm SL, Panamá. C. UCR 442-2, 370 mm SL, Costa Rica.

increases with size: dentary from 15–18 to 21–32; palatine from 10–13 to 12–22; vomer from 5–9 to 8–15; and premaxillary from 15–21 in the three smallest specimens (and also the 97.4 mm specimen) to 29–39 in the seven adults (and also the 92.1 mm specimen).

The papillae along the lateral line are all simple in the four smallest specimens (28.7–92.1 mm), the anteriormost few are branched in the 97.4 mm specimen, most are branched in the 213 and 215 mm specimens, and they are branched the length of the lateral line in the five largest specimens (306–370 mm). The branching of the barbels on the head becomes increasingly complex with age (compare Fig. 1c of the head of a 250 mm SL specimen with Fig. 2 of a 370 mm specimen). Specimens smaller than 250 mm have reduced branching. Caudal ocelli (Fig. 3) are present on the tails of the three largest specimens (329, 355, and 370 mm) but not on the nine smaller specimens (28.7–306 mm).

Range: Central American coast of Caribbean Sea. Originally described from a specimen from Colon Reef, Panamá, and now also known from Costa Rica and Honduras, as well as several additional Panamanian localities.

Material Examined: PANAMÁ: USNM 81009 (329); Colon Reef; S. E. Meek and S. F. Hildebrand; 6 May 1912; holotype. UP 736 (355); María Chiquita, about 17 km NE of Colon; 5 May 1973. MCZ 44549 (28.7); Canal Zone, Ft. Sherman; I. Rubinoff; 16 June 1964. MCZ 44550 (36.0); Canal Zone, Ft. Sherman; I. Rubinoff; 26 July 1964. SIO 67–45 (2, 29.5–92.1); Toro Point; R. Rosenblatt, I. and R. Rubinoff; 23 March 1967. UMML 22522 (97.4); Canal Zone; Pulpit Point, W Shore Limón Bay; R/V Pillsbury 319; 4 July 1966.

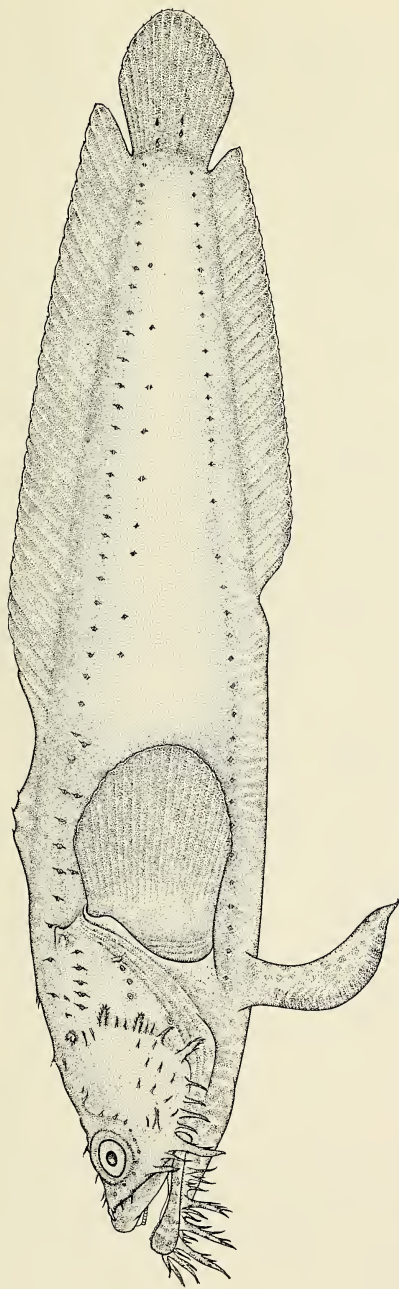


FIG. 4. *Sanopus johnsoni* Collette and Starck, n.sp. (holotype, USNM 205945, 253 mm SL, Cozumel I., México). Drawn by Keiko Hiratsuka Moore.

COSTA RICA: UCR 442-2 (370); Limón Prov.; Isla Uvita off Puerto Limón; W. and M. Bussing and R. Nishimoto; 4 October 1970.

HONDURAS: UMML 31257 (306); The Town, Guanaja (Bonacca); G. C. Miller; 5 May 1967. USNM 211322 (3, 213-306); The Town, Guanaja (Bonacca); G. C. Miller, 6 May 1967.

Sanopus johnsoni Collette and Starck, new species

Fig. 4

Diagnosis: *S. johnsoni* is most similar to *S. barbatus* in general color pattern (uniform brown with reticulated belly), counts of fin rays and vertebrae, measurements, and in having branched chin barbels. The chin barbels are longer and thinner in *S. johnsoni* than in *S. barbatus* and the branches are longer, thinner, and fewer in number (compare Fig. 1d and 1c). The papillae along the lateral line are longer and thinner in *S. johnsoni* than in any of the other species of the genus (compare Fig. 5a-c with 5d). There are a number of long, thin cirri on the interorbital region in *S. johnsoni* that are absent in *S. barbatus*. They are also absent in *S. splendidus* and only a few are present in *S. astrifer*. The pectoral fin is longer than in *S. barbatus* (175 vs. 157-166 thousandths of SL, Table 2).

Dorsal fin rays III, 32; anal fin rays 25; pectoral fin rays 22; vertebrae 11 + 28 = 39; upper lateral line papillae 37; lower lateral line papillae 32; dentary teeth 20-21; palatine teeth 14-15; and total vomerine teeth 10. Premaxillary teeth more numerous (R-38, L-48) than the range in *S. barbatus* (29-37).

Etymology: Named in honor of Mr. J. Seward Johnson in recognition of his generous and extensive patronage of marine science.

Habitat: The holotype was speared at night as it rested part way out of a small cave under a coral head. Another individual was seen among the rock and coral on top of the reef near the same location on another night dive. It retreated into a crevice after a few seconds exposure in the beam of the diving light. The stomach of the holotype was empty but the intestine was greatly distended, chiefly with parts of the spines and test of a small specimen of sea urchin, *Diadema antillarum*.

Holotype: USNM 205945 (253); México; Quintana Roo; Cozumel I., Palancar Reef near S end of island, just inside drop-off at 8 m; Walter A. Starck, II; 30 September 1968.

→

FIG. 5. Anterior portion of lateral line in four species of *Sanopus* showing differences in shape of papillae that protect the neuromast dorsally and ventrally. A. *S. astrifer* (USNM 209720). B. *S. splendidus* n.sp. (USNM 205944). C. *S. barbatus* (USNM 211322). D. *S. johnsoni* n.sp. (USNM 205945).

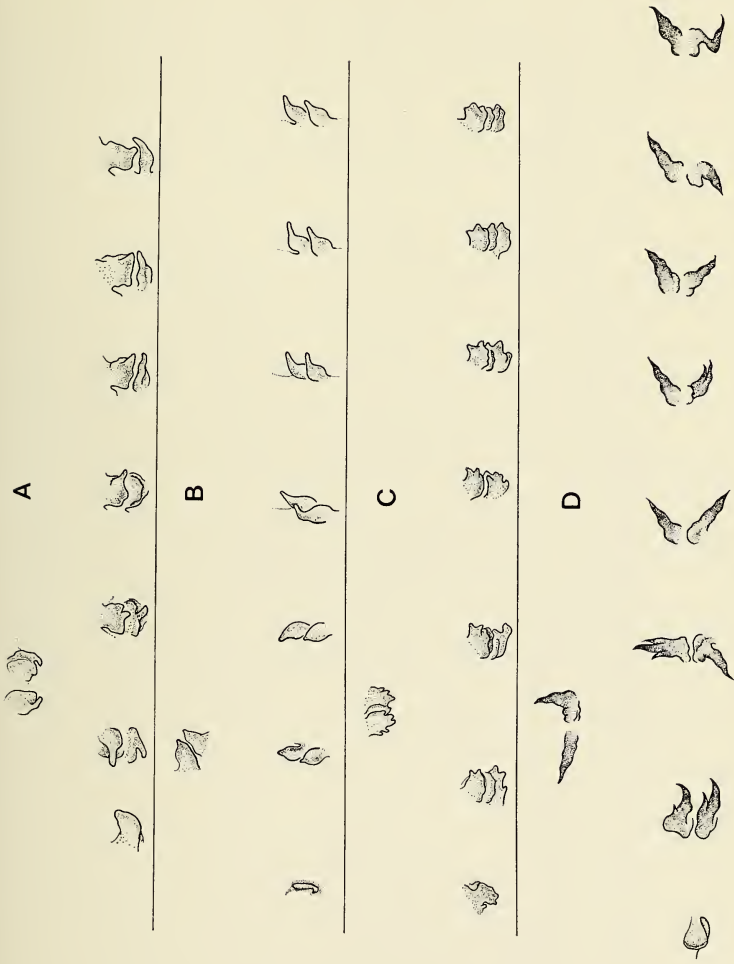


TABLE 2. Morphometric comparison (in thousandths of standard length) between the four species of *Sanopus* and two size classes of *S. barbatus* and *S. astrifer*.

Character	Adults						Juveniles			
	<i>S. barbatus</i> (N = 7)		<i>S. astrifer</i> (N = 3)		<i>S. splendidus</i> (N = 6)		<i>S. barbatus</i> (N = 5)		<i>S. astrifer</i> (N = 4)	
	Range	\bar{x}	Range	\bar{x}	Range	\bar{x}	Range	\bar{x}	Range	\bar{x}
SL (mm)	213-370	304.1	233-245	238.0	217-252	237.0	28.7-97.4	56.7	24.7-72.9	41.4
Head length	341-397	370.6	354-368	362.7	338-356	345.8	349-373	360.2	370-383	376.3
Head width	295-316	309.9	323-333	328.3	290-314	299.5	247-259	250.6	268-293	278.0
Orbital	34-47	42.7	44-50	47.7	40-52	46.2	62-92	79.0	64-81	72.2
Interorbital	85-95	89.7	84-94	88.0	69-77	73.5	64-84	69.8	81-93	89.0
Snout-second dorsal fin origin	427-451	439.6	420-487	451.0	423-439	432.5	417-431	421.8	439-463	447.8
Snout-anal fin origin	572-635	594.6	579-597	590.7	583-604	594.0	533-573	557.0	530-551	540.8
Pectoral fin length	157-166	162.4	193-219	208.0	158-203	178.6	187-223	205.0	213-247	227.3
Pelvic fin length	131-158	147.6	144-180	164.3	154-203	170.0	183-216	201.6	172-226	204.8

Sanopus astrifer (Robins and Starck)

Fig. 6

Opsanus astrifer Robins and Starck, 1965:247–250 (original description; Turneffe Is., British Honduras; USNM 259421-F1; fig. 1, table 1). Greenfield and Greenfield, 1973:564 (reported from Glovers Reef, Belize).

Sanopus astrifer.—Collette, 1966:848 (transferred to *Sanopus*).—Randall, 1968:285 (listed).

Diagnosis: Differs from the other three known species of *Sanopus* in having the dorsum dark with prominent white spots. Most similar to *S. splendidus* in having unbranched chin barbels and generally lower counts. The barbel at the corner of the mouth is about the same size as those on the chin, not wider and longer as in *S. splendidus* (compare Figs. 1a and 1b). *S. astrifer* has the broadest head of the four species (323–333 vs. 290–316 thousandths of SL) but is similar to the other species in most other measurements (Table 2).

Frequency distributions of counts (except teeth) are presented in Table 3. Dorsal fin rays III, 30–31; anal fin rays 24–25; pectoral fin rays 21–22, usually 22; vertebrae 11 (rarely 12) + (26–28) = 37–39, usually 37–38; upper lateral line papillae 37–41; lower lateral line papillae 33–36; dentary teeth 23–24 (\bar{x} 23.7); palatine teeth 13–16 (\bar{x} 14.8); premaxillary teeth 33–44 (\bar{x} 39.0); and total vomerine teeth 10–11 (\bar{x} 10.7).

Changes with growth: The three largest specimens (233–245 mm SL) were compared with the four smallest (one 72.9 mm, three 24.7–37.6 mm). Morphometrically (Table 2), the four smallest specimens had longer heads, orbits, pectoral fins, and pelvic fins and smaller head width and snout to anal distances. Meristically, counts of fin rays, vertebrae, and lateral line papillae do not change within this size range. The number of teeth increases on the vomer (8–9 vs. 10–11), dentary (18–19 vs. 23–24), and premaxillary (32–34 teeth in the 72.9 mm specimen vs. 36–44), but not on the palatine (14–16 vs. 13–16).

Habitat: The types and three specimens recently collected by Dr. Greenfield all came from caves or hollows underneath *Montastrea* coral heads, *M. annularis* in the case of the Greenfield specimens. Most specimens were taken over sand but one was resting on coral (Robins and Starck, 1965; D. W. Greenfield, pers. comm.). The individual taken on the coral “produced loud grunts and thumps” when speared by Dr. Greenfield.

Range: Caribbean, Belize (British Honduras). Described from Turneffe Is., and now also known from Glovers Reef (Greenfield and Greenfield, 1973).

Material Examined: Belize (British Honduras). USNM 259421-F1 (holotype, 236); UMML 9415 (paratype, 73); and ANSP 102736 (3 paratypes, 25–38); Turneffe Is., 200 yards ESE of Cay Bokel in a coral cave at 5 m; W. A. Starck II and E. N. Belcher III; 30 June 1961.

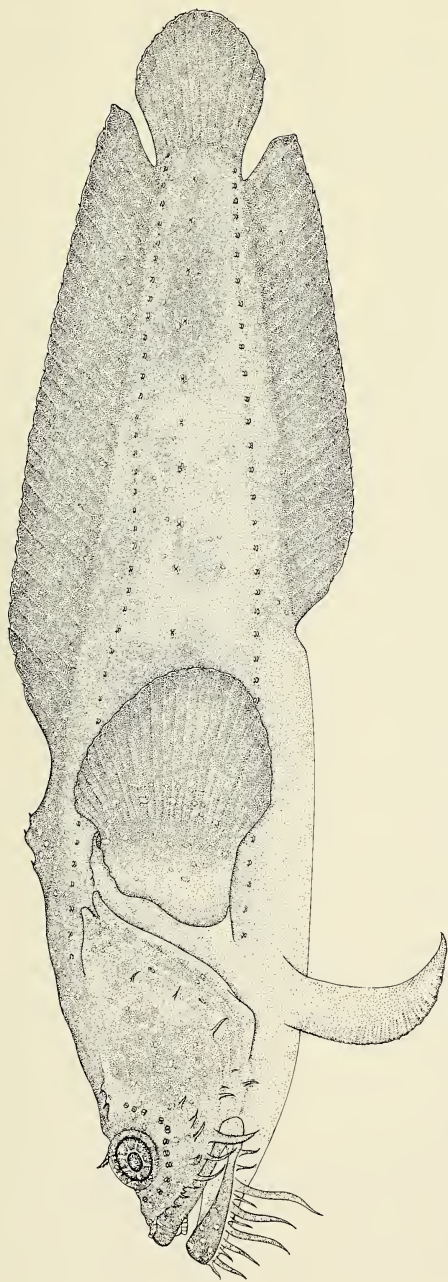


FIG. 6. *Sanopus astrifer* (holotype, USNM 259421-F1, 236 mm SL, Belize). Drawn by Keiko Hiratsuka Moore.

FMNH 71318 (1, 233); Glovers Reef, Southwest Cay outside of lagoon; D. W. and T. Greenfield 71-66; 18 August 1971. USNM 209720 (1, 245); Glovers Reef, patch reef inside of lagoon off Long Cay at 3 m; D. W. Greenfield 70-128; 22 December 1970.

Sanopus splendidus Collette, Starck and Phillips, new species

Plate 1 and Fig. 7

Opsanus superbus Korthaus, 1973:240 (Cozumel; color photograph, *nomen nudum*).

Diagnosis: The most brightly colored species of *Sanopus*. Differs from the other three known species in having all the fins, except the first dorsal, broadly bordered with bright orange-yellow in life (white in preservative). Body ground color dark bluish-gray with numerous alternating narrow and wider dark-bordered crossbars on head and body posterior to the second dorsal fin origin (Pl. 1 and Fig. 7). The barbel at the corner of the mouth is much wider and longer than in the other species of *Sanopus* (Fig. 1). Similar to *S. astrifer* in having conical, unbranched chin barbels and in lower average counts of second dorsal rays and caudal and total vertebrae (Table 3). Interorbital width narrower (69-77 thousandths of SL compared to 84-95 in the other three species, Table 2).

Dorsal fin rays III, 29-30; anal fin rays 25; pectoral fin rays 21-23, modally 22; vertebrae $11 + 26 = 37$; upper lateral line papillae 30-34; lower lateral line papillae 28-30; dentary teeth 23-32 (\bar{x} 27.7); palatine teeth 13-19 (\bar{x} 16.5); premaxillary teeth 35-42 (\bar{x} 39.2); and total vomerine teeth 7-13 (\bar{x} 10.8).

Habitat: The three specimens collected by the Starcks, plus another individual seen in the field, were all at depths of 10-15 m on the narrow shelf of shoal water along the western side of Cozumel Island. None were seen by the Starcks at greater depths during numerous dives along the outer edge of the shelf. Each was in a small cave under a coral head, facing outwards with its head just inside the entrance. An individual observed at night rested partly outside of its cave. The stomachs of these three specimens were empty but the intestines of two contained small fish bones, small gastropods, and bristles that may be setae of polychaete worms. Hans Flaskamp (pers. comm.) reported that the species was common in sand-floored caves under rocks or corals at depths of 10-25 m.

Range: Known only from Cozumel Island, Quintana Roo, México. None were seen by the Starcks in several days diving along the mainland coast of Yucatan.

Holotype: USNM 205944 (245); Cozumel Is., about 200 m offshore of middle of W coast of island at 10 m; Jo D. Starck; 28 September 1968.

Paratypes: ANSP 117316 (225); Palancar Reef near S end of island, just inside drop-off at 15 m; Jo D. Starck; 26 July 1970. UMML 29141 (217); same locality at 8 m; Walter A. Starck II; 1 October 1968. USNM

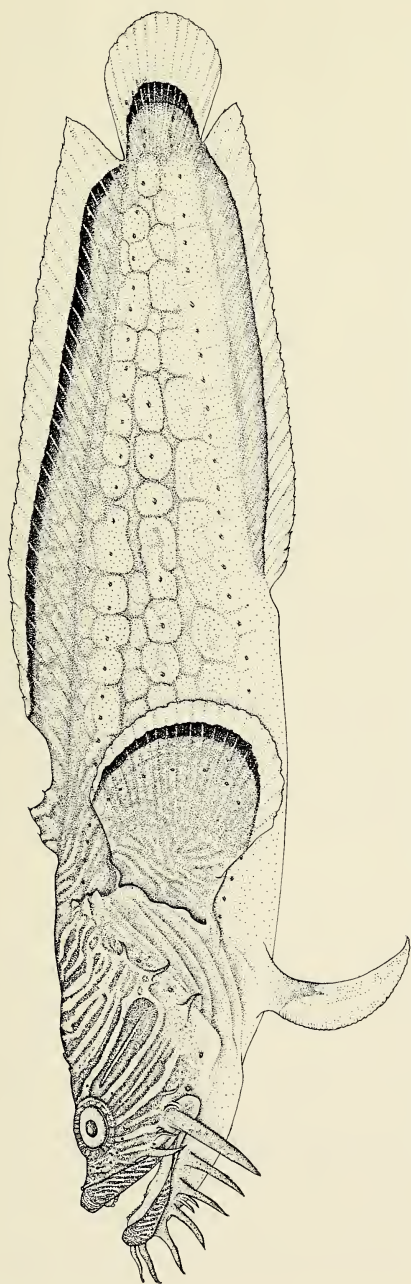


FIG. 7. *Sanopus splendidus* Collette, Starck and Phillips, n.sp. (holotype, USNM 205944, 245 mm SL, Cozumel I., México). Drawn by Keiko Hiratsuka Moore.

205606 (♀, 252); Cozumel Is., 12 m from shore off seaward coast at 3.5–4.0 m; N. Neilson; 6 January 1970. USNM 205607 (♀, 246); same locality; N. Neilson; August 1970. CAS 29110 (250); Cozumel Is.; N. Neilson; 1971.

DISCUSSION

The lack of pectoral fin glands is the primary reason that *Sanopus* is recognized as distinct from *Opsanus*. As previously shown (Collette, 1966:848), the presence or absence of pectoral fin glands and of the axillary gland is a useful character at the generic level in the Batrachoididae. A suite of other characters (Table 1) shows the four species of *Sanopus* to be much more closely related to each other than to any of the four known species of *Opsanus*: *beta* Günther in Goode and Bean, *pardus* Goode and Bean, *phobetron* Walters and Robins, and *tau* (Linnaeus). Furthermore, the two genera occupy different habitats and are almost completely separated geographically: *Sanopus* lives on coral reefs along the Caribbean coast of Central America; *Opsanus* is found in the Gulf of Mexico to Yucatan (plus one record of *O. beta* from Belize, Greenfield and Greenfield, 1973), the Bahamas, and along the east coast of the United States over a variety of bottom types other than coral reefs.

Sanopus can be divided into two species groups. 1. *S. barbatus* and *S. johnsoni* are sombre-colored brown toadfishes, frequently with mottled bellies. Both species have branched chin barbels and higher average numbers of second dorsal rays, caudal vertebrae and total vertebrae. 2. *S. astrifer* and *S. splendidus* are strikingly patterned and have conical, unbranched barbels and lower average numbers of dorsal rays, caudal vertebrae and total vertebrae. The only case of sympatry in *Sanopus* is of *S. splendidus* and *S. johnsoni* at Cozumel; however, the ranges of *S. astrifer* and *S. barbatus* almost overlap. *S. barbatus* extends from Panamá to Honduras and *S. astrifer* occurs in Belize.

COMPARATIVE MATERIAL EXAMINED

Opsanus beta. FLORIDA: USNM 158548 (1, 186); Clearwater. USNM 21477 (lectotype of *O. beta*, 200); Pensacola. USNM 23541 (paralectotype of *O. beta*, 185); Punta Rassa. ANSP 68629 (1, 175); Sand Key; holotype of *O. vandeuseni* Fowler. TEXAS: USNM 746 (2 paralectotypes of *O. beta*, 104–145); Indianola. MÉXICO: USNM 192217 (1, 101); Yucatan, Ascension Bay. USNM 199218 (1, 73); Yucatan, Ascension Bay. USNM 192354 (2, 44–58); Quintana Roo, Mujeres Is.

Opsanus pardus. FLORIDA: USNM 22317 (2 syntypes of *O. pardus*, 314–324); Pensacola. USNM 73173 (1, 116); Anclote. USNM 142837 (1, 76); Pepperfish Keys. UMML 189 (1, 182); Dry Tortugas. UMML 4220 (1, 200); Ft. Myers.

Opsanus phobetron. BAHAMA Is.; Bimini: 5 paratypes of *O. phobetron*. USNM 170961 (1, 127). USNM 170962 (1, 87). ANSP 79480 (1,

119). ANSP 79481 (1, 114). UMML 498 (1, 114). Also: UMML 27128 (1, 129); Bimini. MCZ 34708 (1, 25); Eleuthera. CUBA: MCZ 12751-4 (4, 56-154).

Opsanus tau. NEW YORK: USNM 48976 (1, 131); Peconic Bay. MARYLAND: USNM 45460 (1, 143); Cornfield Harbor. VIRGINIA: USNM 91202 (2, 74-83); Lewisetta. GEORGIA: USNM 258056-F10 (1, 118); Sapelo Is. FLORIDA: USNM uncat. (1, 125); Cape Canaveral. USNM 18034 (1, 161); Matanzas R. Inlet.

ACKNOWLEDGMENTS

The initial stimulus to write this paper was provided by George C. Miller (NMFS Southeast Fisheries Center, Miami) and David W. Greenfield (Northern Illinois University) by their collecting fresh material of *S. barbatus* and *S. astrifer*, respectively. Information and material was provided by John Bleck (University of California, Los Angeles), James E. Böhlke (ANSP), William Bussing (UCR), C. E. Dawson (Gulf Coast Research Laboratory, Ocean Springs, Miss.), William N. Eschmeyer (CAS), Richard H. Goodyear (UP), Robert K. Johnson (FMNH), John E. McCosker (CAS), C. Richard Robins (UMML), Richard Rosenblatt (SIO), and Robert Schoknecht (MCZ). W. A. Starck, II acknowledges the National Geographic Society for its support of his work in the western Caribbean Sea. The original color photograph of *Sanopus splendidus* was taken by Hans Flaskamp. It appears here through the courtesy of Herr Flaskamp and Edith Korthaus, editor of *Das Aquarium*, where the photograph was originally published. The figures were drawn by Keiko Hiratsuka Moore and the radiographs were taken by George Clipper, Susan Stephens, Eugenia Böhlke, and Frank McKinney. Drafts of the manuscript were reviewed by Daniel M. Cohen, Thomas H. Fraser, Carter R. Gilbert, David W. Greenfield, George C. Miller, C. Richard Robins, and Victor G. Springer.

LITERATURE CITED

- COLLETTE, BRUCE B. 1966. A review of the venomous toadfishes, subfamily Thalassophryninae. *Copeia* 1966 (4):846-864.
- GREENFIELD, DAVID W. AND TERRY GREENFIELD. 1973. *Triathalassothia gloverensis*, a new species of toadfish from Belize (= British Honduras), with remarks on the genus. *Copeia* 1973 (3):560-565.
- KORTHAUS, EDITH. 1973. Anglerfisch *Opsanus superbis* Phillips. *Das Aquarium* No. 48:240.
- MEEK, SETH E. AND SAMUEL F. HILDEBRAND. 1928. The marine fishes of Panama. Part III. *Field Mus. Nat. Hist. Publ. no. 249, Zool. Ser. 15(3):709-1045.*
- RANDALL, JOHN E. 1968. *Caribbean reef fishes*. T.F.H. Publ., Inc., Jersey City, N.J. 318 pp.
- ROBINS, C. RICHARD AND WALTER A. STARCK, II. 1965. *Opsanus*

- astrifer*, a new toadfish from British Honduras. Proc. Biol. Soc. Wash. 78:247-250.
- ROUX, CH. 1971. Révision des poissons marins de la famille des Batrachoididae de la côte occidentale Africaine. Bull. Mus. Nat. Hist. Nat., ser. 2, 42(4):626-643.
- SMITH, J. L. B. 1952. The fishes of the family Batrachoididae from South and East Africa. Ann. Mag. Nat. Hist., ser. 12, 5:313-339.
- WALTERS, VLADIMIR AND C. RICHARD ROBINS. 1961. A new toadfish (Batrachoididae) considered to be a glacial relict in the West Indies. Amer. Mus. Novitates No. 2047, 24 pp.